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**NIOSH Safety and Health Topic:** 

# **Chest Radiography**

**Draft Topic Page for Comment and Review NIOSH Docket #085** May 22, 2006

## **Draft Topic Page for Public Review and Comment**

The National Institute for Occupational Safety and Health (NIOSH) invites comment on the Topic Page, Chest Radiography -NIOSH Docket #085

> The information contained in this Topic Page is still in draft form and as such should not be considered as a final statement of NIOSH policy.

NIOSH requested public comments on a previous draft of this Topic Page by Federal Register Notice (November 17, 2005, Volume 70, Number 221, Page 69765-69766). We thank all commenters for reviewing and commenting on the prior version. Links to the Prior Draft (Adobe PDF 142KB), the Comments Received (Adobe PDF, 4 MB) on the prior draft and our NIOSH responses (Adobe PDF, 28 KB) to those comments are now posted. This page and the pages linked below comprise the new revised draft Chest Radiograhy Topic Page on which we again invite your comments. Comments are due on or before October 1, 2006.

To submit comments regarding this draft topic page, please use one of these options:

- Send NIOSH comments using this online form
- Send NIOSH an email at nioshdocket@cdc.gov
- Fax comments to the NIOSH Docket Office: 513-533-8285
- . Send by Mail to:

NIOSH Mailstop: C-34 Robert A. Taft Lab. 4676 Columbia Parkway Cincinnati, Ohio 45226

## **Evaluating Occupational Lung Disorders**

The purpose of this NIOSH Safety and Health Topic Page is to provide information about radiographic classification for the pneumoconioses and certain other occupational respiratory diseases. Radiographic classification issues, such as its history and development; how it relates to medical diagnosis, research, worker monitoring, government programs, and contested proceedings; best practices for those different settings; and how to become a NIOSH B Reader, are included. Throughout these pages, it is assumed that radiographic classification is being undertaken using the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses.

A summary of criteria that NIOSH considers best practices for reliable classification of radiographs by B readers is provided here.

### **Reliability of Classifications**

Settings employing radiographic classifications include worker medical monitoring, epidemiologic research, government programs, and privately contested proceedings typically involving compensation. In each of these, an important objective is to obtain information having appropriate reliability for the setting. In this, the need for reliability must be balanced against the various social and monetary costs involved.

Apart from using appropriate methods for image collection and viewing and a dedication to ethical classification practices, attention to reader competency and radiographic classification practices is necessary to obtain valid and reliable classifications. Proper reader training and assessment, such as that supplied by the NIOSH B reader program, ensures that readers have the appropriate knowledge and skills. Appropriate radiographic classification methods tailored to the specific setting will limit problems of bias and excessive variation that can otherwise arise.

Reliability implies both accuracy and precision. Accuracy denotes lack of bias, while precision denotes lack of undue variation. They are independent concepts: there can be precision without accuracy and accuracy without precision. In radiographic classification, the approaches used to optimize accuracy are typically different from those used to optimize precision.

In the associated topic pages, information is provided in detail on ensuring reader competency (NIOSH B reader program) and on principles of radiographic classification methods. Attention is drawn to the information presented on issues in radiographic classification, which discusses accuracy, precision, and reader variability and page on ethics for B readers.

## Chest Radiography



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This material is critical reading for those involved in radiographic classification. Application of the methodological information presented here, coupled with use of NIOSH B Readers (or readers otherwise trained and assessed to the same, high standard), should lead to classifications having accuracy and precision appropriate for the intended setting.

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NIOSH B Reader Certification Program



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## The NIOSH B Reader Certification Program

## **Background**

#### History and Need

In 1949, the International Labour Organization (ILO) promulgated standards for reading and interpreting chest radiographs. The intent of the standards was to achieve uniformity in assessing pneumoconiosis. However, it was found that readers, despite employing the classification scheme, still disagreed with each other and with themselves to an excessive degree (Felson 1973). As a consequence, the National Institute for Occupational Safety and Health (NIOSH) concluded that a proficiency certification program was needed to provide a pool of qualified readers. The NIOSH B Reader Program began in 1974; although, it was not until 1978 that the certification exam was given extensively (Attfield 1992).

## Intent/Objective

The B Reader examination was originally developed to identify physicians qualified to serve in national pneumoconiosis programs directed at coal miners and others who suffer from dust-related illness. This originally included epidemiologic research on coal workers' pneumoconiosis and the compensation of coal miners with pneumoconiosis under programs processed by government agencies (Morgan 1979). The original intent of the B Reader Program still exists, but B Readers are also now involved with epidemiologic evaluation and surveillance programs involving many types of pneumoconioses. By evaluating the ability of a reader to classify a test set of radiographs and certifying only those who achieve a certain level of proficiency, the B Reader Program is intended to ensure that physicians who read chest radiographs for evidence of pneumoconiosis using the International Labour Office (ILO) Classification system are as accurate and precise as possible.

#### Utility of B Reading

The B Reader test simply ensures that readers can demonstrate a certain competency in classifying a set of radiographs for the pneumoconioses and related diseases using the ILO system. The utility of the ILO system is now internationally accepted, having been repeatedly shown to lead to data appropriate for assessing disease prevalence, incidence, and its relationship to measured dust exposures. As Jacobsen has noted: "There are now several examples testifying to the value of the classification system in epidemiologic studies of the relationships between the occurrence, nature and intensity of pneumoconiotic appearances and the levels of exposure to dust of the individuals concerned. Quantitative statements about such exposure-response relationships play a key role in decision-making with respect to occupational and environmental hygiene standards." (Jacobsen 1991)

### B Reading and the Law

The Federal Coal Mine Health and Safety Act was passed in 1969 following escalating concerns about coal workers' pneumoconiosis and the rising number of fatalities due to mining accidents. The Act was then updated in 1977 (Federal Mine Safety and Health Act of 1977, Public Health Law 91-173). One of the provisions of the Act was to provide preventive as well as compensatory services to miners afflicted with coal workers' pneumoconiosis (CWP) (see next section). Radiographs taken under the Act's provisions must be interpreted using the International Labour Office (ILO) Classification system and interpreted first by an A or B Reader. All subsequent readings must be done by a certified B Reader (42CFR37 external link). Another program is the Asbestos Medical Surveillance Program (AMSP) (external link), administered by the Navy Environmental Health Center. The Occupational Safety and Health Administration (OSHA) asbestos standard requires that chest radiographs obtained for surveillance of those exposed to asbestos be interpreted and classified by a B Reader, radiologist, or physician with expertise in pneumoconioses. OSHA (external link) also specifies B Readers and the International Labour Office (ILO) Classification in its asbestos safety and health standards for general industry, construction, and shipyard employment.

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#### Example of B Reading at work: the NIOSH Coal Workers' Health Surveillance Program (CWHSP)

The NIOSH CWHSP is a surveillance program that was established as part of the Federal Mine Safety and Health Act of 1969. This program allows all underground coal miners the opportunity to receive chest radiographs for pneumoconiosis evaluation at no cost to the miner. Regulations mandate that all physicians who participate in the examination and/or classify chest radiographs under the Act must utilize the ILO Classification system and the ILO Standard Films for comparisons. B Readers evaluate the radiographs from the CWHSP for evidence of pneumoconiosis and use those findings to aid in the prevention of pneumoconiosis and to prevent the disease from progressing to a more advanced state. The first step in evaluating a radiograph for the CWHSP is for an A reader or B Reader from a NIOSH-approved radiographic facility to review the radiograph for coal workers' pneumoconiosis (CWP). Then the radiograph is sent to NIOSH where a B Reader reads the radiograph. If there is agreement, the miner is notified of the results. If there is not agreement between the two readers, then a third B Reader classifies the radiograph. If there is agreement between 2 of the 3 readers, a final determination is sent to the miner. If no agreement is obtained, the radiograph is read by a panel of B Readers, and their classification is considered the final determination. This is then sent to the miner (42CFR37 external link). For more information on the CWHSP, visit the CWHSP Web site.

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## Certification

\* If you are a physician interested in becoming a B Reader, follow this link for more information (B Reader Information for Medical Professionals).

#### **Exam Description and Certification Process**

The B Reader examination process has been in existence since 1978 with prototype development starting in 1974. The examination consists of the classification of 125 chest radiographs over a period of 6 hours. The test is scored out of 100 points with a passing score being a combined score of fifty or more points. There are six sections to the examination: small opacities (3 parts), large opacities, pleural abnormalities, and other abnormalities with the scoring weighted towards parenchymal abnormalities (60%). From 1987 to 1990, about 47% of readers passed the examination. Once certified a reader must recertify every four years (see Recertification below).

#### Reader Training

NIOSH strongly recommends pre-test preparation for examination participants to assure familiarity with the International Labour Office (ILO) Classification system and associated Roentgenographic Interpretation Form.

NIOSH Home Self-Study Syllabus

The Syllabus is available by mail in the U.S. on a first-come, first-served basis from the Appalachian Laboratory for Occupational Safety and Health (ALOSH) prior to scheduled testing. Additionally, the Syllabus may be used on-site by anyone interested in coming to Morgantown to study prior to taking the examination. To request the Syllabus, contact the CWHSP at (888) 480-4042 or email <a href="mailto:CWHSP@cdc.gov">CWHSP@cdc.gov</a>.

American College of Radiology Symposium on Pneumoconioses

The American College of Radiology (ACR) Symposium on Radiology of the Pneumoconioses is usually held every 2-3 years. The last symposium was held March 2004, in McLean, Virginia.

#### Calendar of Events

Exams are offered monthly at ALOSH. For scheduled dates, please call (888) 480-4042 or email <a href="mailto:CWHSP@cdc.gov">CWHSP@cdc.gov</a>.

The ACR does offer testing during their symposiums. For more information on ACR symposiums, please visit their Web site at American College of Radiology (external link).

### Recertification

The recertification process began in 1984. B Readers must recertify every four years; however, physicians may recertify during their last year of certification. The recertification exam is very much like the certification exam, except readers are required to classify only fifty radiographs. If a reader fails the recertification exam, they must take the original certification examination before expiration of their current certification in order to remain

# Related NIOSH Topics:

Occupational Respiratory Disease
Surveillance

Coal Workers' Health Surveillance
Program

certified. There is no waiting period between failing the recertification and taking the certification exam. However, if they fail the certification exam, readers must wait six months before retaking it (Wagner 1993). B Readers who do not take the recertification exam before expiration of their certification automatically become A Readers.

## **A Readers**

An A Reader is a physician who has demonstrated proficiency in classifying the pneumoconioses by one of three methods. They may submit to the Appalachian Laboratory for Occupational Safety and Health (ALOSH) six sample chest radiographs, which they have properly classified. These radiographs will be evaluated by a panel of B Readers. The six radiographs must include two films without pneumoconiosis, two films with simple pneumoconiosis, and two films with complicated pneumoconiosis. The second method for becoming an A Reader requires satisfactory completion of one of the American College of Radiology's Symposium on the Classification of Radiology for the Pneumoconioses. Finally, B Readers who fails to recertify before the expiration of their certification automatically become A Readers.

# **New Developments and Future Challenges**

## Digital Radiography

Conventional film screen chest radiography has been widely applied in assessing lung health in dust-exposed workers for decades, but this technique is being replaced by digital radiography systems. NIOSH is currently assessing the equivalency of traditional radiography and digital radiography with respect to pneumoconiosis classification using conventional and digital images from patients with a spectrum of dust-related lung disorders and chest pathology. However, until authoritative recommendations applicable to use of digital images have been specified, NIOSH recommends that B Readers using the ILO Classification continue to use traditional film screen radiographs and standards.

#### ILO 2000 Revisions

The ILO revised its Classification system in 2000 and published updated Guidelines in 2002. To assure adherence to this new system, NIOSH has modified the B Reader examinations and related training activities and materials, including the Self-Study Syllabus and Film Set. The goal of this effort is to maintain the NIOSH B Reader Program as a contemporary and relevant quality assurance program for the classification of chest radiographs for occupational lung disease research and prevention.

## Syllabus on Compact Disc

Currently, the Self-Study Syllabus and Film Set are available by mail in the United States from NIOSH on a first-come, first-served basis. Additionally, the Syllabus may be used on-site by anyone interested in coming to NIOSH, Morgantown or at nine other locations across the country and at 18 international sites. NIOSH is working to put the entire Self-Study Syllabus and Film Set on compact disc to increase availability of the Syllabus to each test taker.

## **Comments or Concerns**

## Comments or Concerns about the B Reader Certification Program

The B Reader Certification Program welcomes any comments or concerns about the Program, the examination, or this Web site. Our goal is to serve all persons who interact with this Program and continuously improve the information that we provide. Please use any of the following contact methods:

Call the Program office at (888) 480-4042

Email us at <a href="mailto:CWHSP@cdc.gov">CWHSP@cdc.gov</a>

Mail the Program at:

ALOSH/NIOSH Surveillance Branch Coal Workers' Health Surveillance Activity P.O. Box 4258 Morgantown, WV 26504

#### Comments or Concerns about Specific B Readers

The purpose of the B Reader Certification Program is to train licensed physicians in use of the ILO Classification System and to certify their ability to apply the ILO Classification System in classifying chest radiographs for the presence and severity of changes potentially associated with exposure to dusts such as asbestos, silica, and coal mine dust. Classifying chest radiographs is practicing medicine. In the United States, licensure to practice medicine is regulated at the State level by State medical licensing boards. Physicians should not classify chest films and may not take either the B reader certification examination or quadrennial recertification examinations unless they possess a current, active license to practice medicine. Complaints about a specific physician certified as a B reader should be referred to the appropriate State medical licensing board, as these boards are the bodies responsible for assuring competence and integrity of licensed physicians. Contact information for each State's medical licensing board can be found on the Federation of State Medical Boards Web site (external link).

#### References

Felson B, Morgan WKC, Bristol LJ, Pendergrass E, Dessen EL, Linton OW *et al.* Observations on the results of multiple readings of chest films in coal miners' pneumoconiosis. Radiology 1973;109:19-23.

Attfield MD, Morring K. An investigation into the relationship between coal workers' pneumoconiosis and dust exposure in U.S. coal miners. *Am Ind Hyg Assoc J* 1992; 53:486-92.

Morgan RH. Proficiency examination of physicians for classifying pneumoconiosis chest films. *Am J Roentgenology* 1979;132:803-08.

Jacobsen M. Part 5. Radiologic Abnormalities: Epidemiologic Utilization: The International Labour Office Classification: Use and Misuse. *AnnalsNew YorkAcademy of Sciences* 1991; 643:100-107.

Federal Mine Safety and Health Act of 1977, Public Health Law 91-173

Specifications for Medical Examinations of Underground Coal Miners. 42CFR37

External Link: http://www.access.gpo.gov/nara/cfr/waisidx\_02/42cfr37\_02.html

Asbestos Medical Surveillance Program. Navy Environmental Health Center

External Link: http://www-nehc.med.navy.mil/occmed/Asbestos.htm

Safety and Health Topics: Asbestos. Occupational Safety and Health Administration

External Link: http://www.osha.gov/SLTC/asbestos/index.html

Coal Workers' Health Surveillance Program. National Institute for Occupational Safety and Health

Roentgenographic Interpretation Form. B Reader Certification Program. National Institute for Occupational Safety and Health

American College of Radiology

External Link: http://www.acr.org/s\_acr/index.asp

Wagner GR, Attfield MD, Parker JE. Chest Radiography in Dust-Exposed Miners: Promise and Problems, Potential and Imperfections. *Occupational Medicine: State of the Art Reviews* 8(1); 127-141, 1993.

Federation of State Medical Boards

External Link: http://www.fsmb.org/

Evaluating Occupational Lung Disorders

B Reader Information for Medical Professionals





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#### B Reader Information for Medical Professionals

If you are visiting this Web Page, you may be interested in the NIOSH B READER program or you may be curious about becoming approved as a NIOSH B Reader.

- --Do you live in a coal mining area and expect to classify chest radiographs for the Coal Workers' X-Ray Surveillance Program as mandated by the Federal Mine Safety and Health Act of 1977?
- --Have you been asked to classify chest radiographs of asbestos- exposed workers as governed by the U.S. Department of Labor regulations?
- --Are you involved in classifying chest radiographs for medical screening, surveillance, research, or compensation programs?

#### The B Reader Examination

NIOSH B Reader approval is granted to physicians with a valid medical license who demonstrate proficiency in the classification of chest radiographs for the pneumoconioses using the International Labour Office (ILO) Classification System.

Proficiency is evaluated via the NIOSH B Reader Certification Examination, which was developed in response to the mandates of the Federal Mine Safety and Health Act. Since the examination was first administered in 1974, NIOSH has certified more than 1200 physicians. Currently, there are 531 certified B Readers. Upon request, NIOSH will provide a list of all currently certified B Readers.

Examinations are offered monthly at the Appalachian Laboratory for Occupational Safety and Health (ALOSH) located in Morgantown, West Virginia. A passing score results in approval as a NIOSH B Reader. Each B Reader receives a certificate and is required to recertify at four-year intervals. Nearly 56% of NIOSH-certified B Readers renew certification for an additional term.

Regulations mandate that all physicians who participate in the examination and/or classify chest radiographs under the Act must utilize the ILO System and Standard Films. These standard films are necessary when participating in the B Reader Examination or utilizing the NIOSH Self-Study Syllabus, and are an important resource at the American College of Radiology (ACR) Symposium on Radiology of the Pneumoconioses.

#### For more information:

Wagner GR, Attfield MD, Parker JE. Chest Radiography in Dust-Exposed Miners: Promise and Problems, Potential and Imperfections. OCCUPATIONAL MEDICINE: State of the Art Reviews. Philadelphia, Hanley & Belfus, Inc. 1993; 8(1):127-141.

For additional information, you may wish to refer to:

Wagner GR, Attfield MD, Kennedy RD, Parker JE. The NIOSH B Reader Certification Program--An Update Report. JOURNAL OF OCCUPATIONAL MEDICINE. 1992; 34:879-884.

### **New ILO Revisions**

The revised edition (2000) of the Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses has been released. NIOSH is in the process of updating the entire B Reader Program to reflect these changes. Potential B Reader candidates should keep the following in mind:

· B Reader certifications under the previous ILO system will continue to be valid until their date of

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expiration.

- NIOSH has revised both the B Reader certification and recertification examinations to make them
  consistent with the ILO revision.
- A revised <u>Roentogenographic Interpretation Form</u>, consistent with the ILO revision, is now available from NIOSH and is being used in all components of the CWHSP. You may download a copy of the form from this site by clicking on the link above.
- NIOSH now tests all B Reader candidates according to the revised ILO system. Upon the expiration of their certification, current B Readers will be required to recertify under the revised system.

To order copies of the revised edition of the International Classification of Radiographs of Pneumoconioses, use the ILO Web site:

Log onto the <u>ILO</u> Web site External Link: http://www.ilo.org/
Under Highlights (right side of the page), click Publications
Select New Books
Select Titles Alphabetically
Select the letter "I"
Select "ILO Standards-Related Activities in the Area of Occupational Safety and Health"
Then scroll down to "International Classification of Radiographs of the Pneumoconioses" to

During the transition from the 1980 to the 2000 edition of the ILO Classification, readers have asked about the use of different available sets of standard radiographs in classifying films under the current 2000 revision of the Classification.

Two issues have arisen:

order

- 1) The ILO now offers two distinct sets of the standard films, the "Complete Set" consisting of 22 radiographs, and the "Quad Set" consisting of 14 radiographs. Although the two sets are generally comparable, international trials have demonstrated some tendency for film classifications to vary, depending on the set of radiographs used. Thus, for the purposes of classifications under the NIOSH Coal Workers' X-ray Surveillance Program, use of the "Complete Set" is preferred. Readers should consult with the responsible parties regarding this issue when they perform classifications for other purposes, such as research studies, medical surveillance programs, or clinical or medical-legal evaluations.
- 2) In order to preserve continuity and consistency in the classifications, the images used in reproducing the 2000 version of the standard radiographs are identical to those used for the 1980 set of standard radiographs, aside from one image which demonstrates pleural abnormalities. The ILO did endeavor to improve image quality in the 2000 set by utilizing advanced computer image techniques. The NIOSH Coal Workers' X-ray Surveillance Program requires that readers submit classifications adhering to the 2000 Revised Edition of the Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconiosis. The sets of standard images used in the 2000 and 1980 Classifications are nearly identical, and thus it is the individual reader's choice which of these two sets of standard radiographs to use after that time. However, because the quality of the 2000 standard radiographs has been enhanced by the ILO, NIOSH recommends that readers consider using these current standard radiographs for classifying films for NIOSH programs and studies.

## **Pre-Examination Preparation**

NIOSH strongly recommends some pre-test preparation for examination participants to assure familiarity with the ILO Classification System and associated Roentgenographic Interpretation Form. Pre-test preparation is extremely important because anyone who fails the examination must wait six months before re-testing. The examination is difficult and consistently demonstrates a 50/50 pass/fail rate.

Pre-test preparation is offered in the form of (1) the NIOSH Self-Study Syllabus which is available through ALOSH and developed specifically for this purpose; and/or (2) attendance at the American College of Radiology (ACR) Symposium on Radiology of the Pneumoconioses.

The Syllabus is available by mail in the United States on a first-come, first-served basis from ALOSH prior to scheduled testing. Additionally, the Syllabus may be used on-site by anyone interested in coming to Morgantown to study prior to taking the examination. The Syllabus can also be utilized at 9 other stationary locations across the country and 18 international sites. To request the syllabus, contact the CWHSP at (888) 480-4042.

The American College of Radiology (ACR) Symposium on Radiology of the Pneumoconioses is usually held every 2-3 years. The last Symposium was held during March 2004, in McLean, Virginia. You can contact the ACR for further details (800) 227-5463 ext. 4245.

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## **Digital Radiography**

In light of the recent technological advances in radiology, particularly in the area of digital radiology, many B Readers have inquired about the use of digital radiography in the classification of pneumoconioses. Questions have focused on the use of either 'soft copy' images that can be read on a monitor or 'hard copy' digital images that can be printed on film like traditional film-screen radiography (FSR). To comply with regulatory requirements under 42CFR Part 37, B Readers must continue to use standard film screen radiographs when classifying chest radiographs for the Coal Workers' X-Ray Surveillance Program. The regulation specifies the use of film no less than 14 by 17 inches, and the use of a diagnostic radiograph machine having a rotating anode tube with a maximum of a 2 mm. source.

In addition, the guidelines for use of the ILO International Classification of Radiographs of Pneumoconioses prescribe side-by-side viewing of subject and standard radiographs, and state that the standard films take precedence in defining profusion categories. Thus, until provisions for use of digital images have been specified, readers using the ILO Classification for all purposes should continue to use traditional film screen radiographs and standards.

## Roentgenographic Interpretation Form

## Roentgenographic Interpretation Form

Name of the last series of the last series | PDF only 115 KB (2 pages) | En español

(OMB 0920-0020) (CDC/NIOSH 2.8) (October 2003)

This form must be completed by the A or B Reader that interprets a chest radiograph for NIOSH as part of the Coal Workers' X-ray Surveillance Program. Print/Copy as a double-sided form.

## **More Information**

For more information about NIOSH B Reader certification, write or telephone--

ALOSH/NIOSH Surveillance Branch Coal Workers' Health Surveillance Activity P.O. Box 4258 Morgantown, WV 26504 (888) 480-4042

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Ethical Considerations for B Readers



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## **Ethical Considerations for B Readers**

The B Reader Code of Ethics is intended to assist B Readers in recognizing and maintaining a high level of ethical conduct. The outcome of chest radiograph classification can have important medical, legal, and social implications. It is critical that B Readers perform chest radiograph classifications properly and with integrity. This code, modeled after those of the American Medical Association and the American College of Radiology, is a framework to help B Readers achieve this goal.

## B Reader Code of Ethics

The B reader's primary commitment is to serve the welfare and best interests of patients, workers, and society by striving to classify chest radiographs as accurately as possible.

B Readers shall uphold the standards of professionalism, be honest and objective in all professional interactions, and strive to report individuals or enterprises that they know to be deficient in character or competence, or engaging in fraud or deception, to appropriate entities.

B Readers shall recognize the limitations of chest radiograph classifications, and shall not make clinical diagnoses based on chest radiograph classification alone.

When a contemporary chest radiograph is classified, the B-reader must either take responsibility for assuring to the extent feasible that the examined individual is promptly notified of all clinically important findings or must be assured that another appropriate party is taking that responsibility.

B Readers shall respect the law; the rights of patients, other health professionals, and clients; and shall safeguard medical information and other confidences within the constraints of the law.

B Readers shall continue to study and apply advances or changes to the International Labour Office International Classification of Radiographs of Pneumoconioses as specified by the National Institute for Occupational Safety and Health, B Reader Certification Program.

In providing expert medical testimony, B Readers should ensure that the testimony provided is unbiased, medically and scientifically correct, and clinically accurate.

B Readers shall recognize and disclose any conflicts of interest in the outcome of a chest radiograph classification. B Readers shall not accept compensation that is contingent upon the findings of their chest radiograph classifications or the outcome of compensation proceedings or litigation for which they undertake readings.

B Readers shall not advertise or publicize themselves through any medium or forum of public communication in an untruthful, misleading, or deceptive manner.

B readers shall promptly report to the National Institute for Occupational Safety and Health, B Reader Certification Program any revocation or suspension of a medical license, voluntary relinquishment of a medical license or conversion to inactive status, or the voluntary surrender of a medical license while under investigation.

■ B Reader Information for Medical Professionals

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**NIOSH Safety and Health Topic:** 

# **Chest Radiography**

**Draft Topic Page for Comment and Review** NIOSH Docket #085 May 22, 2006

### NIOSH Certified B Readers List

This list will be updated automatically as Readers become certified or do not renew certification. Listing does not imply medical licensure.

Use this search form to select the criteria for your search. Leaving the Last Name and State fields blank will produce a complete list of Certified B readers.

Listed by State of Residence

Last Name

State

Sort by

Format

## Successful International Examinees

Use this search form to obtain a listing of physicians from outside the United States who have demonstrated competence in applying the ILO classification by successfully completing the NIOSH B reader examination. Leaving the Last Name field blank will produce a complete list of examinees.

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Sort by

Ethical Considerations for B Readers

**ILO Classification** 

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## **ILO Classification**

# **History**

The International Labour Organization is a specialized agency of the United Nations that seeks the promotion of social justice and internationally recognized human and labor rights. The Organization formulates international labor standards in the form of Conventions and Recommendations setting minimum standards of basic labor rights: freedom of association, the right to organize, collective bargaining, abolition of forced labor, equality of opportunity and treatment, and other standards regulating conditions across the entire spectrum of work related issues. The International Labour Office (ILO) is the Organization's research body and publishing house (ILO 2002).

A series of guidelines on how to classify chest radiographs for persons with pneumoconioses has been published by the ILO since 1950. The goal of this process was to describe and codify the radiographic abnormalities of the pneumoconioses in a simple, reproducible manner. The most recent edition was revised in 2000 and is described in the 2002 ILO publication Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses (ILO 2002).

## Classification Scheme

The Classification system includes the Guidelines and two sets of standard films. The standard films represent different types and severity of abnormalities and are used for comparison to subject films during the classification process. The system is oriented towards describing the nature and extent of features associated with the different pneumoconioses, including coal workers' pneumoconiosis, silicosis, and asbestosis. It deals with parenchymal abnormalities (small and large opacities), pleural changes, and other features associated, or sometimes confused, with occupational lung disease.

In the present manifestation of the ILO system, the reader is first asked to grade film quality. They are then asked to categorize small opacities according to shape and size. The size of small round opacities is characterized as p (up to 1.5 mm), q (1.5-3 mm), or r (3-10 mm). Irregular small opacities are classified by width as s, t, or u (same sizes as for small rounded opacities). Profusion (frequency) of small opacities is classified on a 4-point major category scale (0 -3), with each major category divided into three, giving a 12-point scale between 0/- and 3/+. Large opacities are defined as any opacity greater than 1 cm that is present in a film. Large opacities are classified as category A (for one or more large opacities not exceeding a combined diameter of 5 cm), category B (large opacities with combined diameter greater than 5 cm but does not exceed the equivalent of the right upper zone), or category C (bigger than B). Pleural abnormalities are also assessed with respect to location, width, extent, and degree of calcification. Finally, other abnormal features of the chest radiograph can be commented upon (ILO 2002). All of these abnormalities are well illustrated and described in the Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses. To see how a classification is recorded, follow this link to the Roentgenographic Interpretation Form used by the NIOSH Coal Workers' X-Ray Surveillance Program.

# **Examples of Normal and Abnormal Radiographs**







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Normal Radiograph	Simple Coal Workers' Pneumoconiosis	Progressive Massive Fibrosis
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## References

International Labour Office (ILO). Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses, Revised Edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva, 2002.

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## **Issues in Classification of Chest Radiographs**

# **Accuracy and Precision**

As with most medical determinations, radiographic classifications are subject to accuracy and precision considerations. Accuracy is defined as the ability for a measurement to reflect the true degree of underlying abnormality, that is, unbiasedness. Precision reflects the extent to which a measurement is consistent across repeated determinations. Both criteria are important - a measurement technique can be precise but inaccurate, or can be accurate and imprecise, but preferably should be both accurate and precise.

## Reader Variability

Inter- and intra-reader variability in chest radiography has existed since chest radiography was first used to identify and classify pneumoconiosis (Fletcher 1949). Inter-reader variability occurs when readers disagree amongst themselves on a classification. Intra-reader variability occurs when a reader classifies a radiograph differently on different occasions. Reader variability prompted the International Labour Office (ILO) to develop the ILO Classification scheme for the pneumoconioses and has prompted its continued revision since then (Bohlig 1970). It was also a catalyst for development of the NIOSH B Reader Program.

Reader variability is probably inherent in radiograph classification for the pneumoconioses. When excessive, reader variability is undesirable because it severely reduces the quality and usefulness of the classification data. Extreme differences can skew study results and, for example, impact eligibility for compensation programs and award of compensation. Lack of agreement among classifications from multiple readers involved in epidemiological or surveillance studies can usually be minimized using appropriate scientific techniques, but radiographic classification in contested settings often results in polarized opinions that are extremely difficult to reconcile (Jacobsen 1991, Ducatman 1991).

Inter-reader variation consists of two components: systematic differences and random variability. Systematic variation between readers, in which one reader persistently reports more or less abnormality than another, is related to bias, and is best handled using techniques that ensure accuracy in radiographic classification (see below). However, despite all attempts, some systematic inter-reader differences may remain. The persistence of reader differences despite intensive measures to assess and correct it is demonstrated by findings for British coal miners. The British National Coal Board had a rigorous quality assurance process for minimization of both interand intra-reader variability. Despite these efforts, reader variability was not totally eliminated (Fay 1959, Hurley 1982). Given this, it may often be prudent to use multiple readers to obtain independent classifications and use an unbiased summary measure, such as the median classification, as the final determination. In this way, the final determination would reflect mainstream classification tendencies as much as possible.

# **Accuracy in Film Classification**

Accuracy in radiographic classification is gained through careful and rigorous reader training and through applying specific conditions designed to eliminate bias during the classification process.

The following bulleted list shows important measures that can be applied to ensure accuracy (note: the same degree of accuracy is not required in all settings where ILO classifications are obtained; recommended practices for each of these settings are provided elsewhere on this web site).

- · Reader selection
- · Classification blinded to knowledge of potential exposures and other information,
- · An environment that does not reward extreme determinations,
- · Concurrent quality control measures

Application of these procedures should help provide unbiased classifications. When they are ignored bias should

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be suspected.

#### Reader selection

Procedures that give rise to unbiased classifications include either selection based on pre-existing evidence of mainstream classification tendencies or random selection from a pool of available readers. Selection of readers based on other criteria leaves the process open to accusations of bias. Proper reader selection procedures are not alone sufficient to ensure accuracy; it needs to be accompanied by an appropriate program of quality assurance.

#### Classification blinded to knowledge of potential exposures and other information

Overall bias can occur when readers have information concerning the radiographs being classified that can consciously or unconsciously influence their classifications. For example, knowledge of worker exposures can bias readers to recording more or fewer abnormalities depending on the extent of the exposure, or preferentially selecting certain types of abnormality depending on the nature of the exposure (e.g., small rounded opacities for silica-exposed workers versus small irregular opacities for asbestos-exposed workers). Blinding readers allows the classification to be made absent of preconceived knowledge and concepts. In order to minimize such bias, any identifying information, such as age, occupation, work site, and medical history should be removed from the radiograph before it is sent for classification. Withholding information on the source of the radiographs, and for whom the classification has been requested (e.g., the plaintiff or defendant in contested proceedings) will also help prevent bias. Among sequential radiographs representing possible temporal trends in disease development or progression, it has been shown that knowledge of the order in which the radiographs were taken influences a reader's classifications (Reger 1974).

#### An environment that does not reward extreme determinations

An environment that rewards the reader for reporting disease more or less clearly leads to bias. It follows that, along with blinded classification, the remuneration should not be linked with the outcome reported by the reader. It also follows that those who seek classifications should not knowingly select readers whose classifications are likely to be biased in a direction that suits their preference.

#### Quality assurance

There are various approaches to quality assurance, some being better than others. Concurrent monitoring of classification levels can be accomplished by adding quality assurance ("calibration") radiographs to the set for which classifications are being sought without the reader being aware of which are the calibration radiographs. For example, a National Institutes of Health-sponsored workshop suggested including chest films of unexposed workers in epidemiologic studies for purposes of quality control (Weill 1975). Optimally, quality assurance radiographs should include a range of abnormality levels and types previously classified by expert readers. There are many benefits to this approach. First, because the reader is unaware of which are the quality control radiographs, yet knows that they exist within the study, the reader is under pressure to conform to standard classification practices. Second, the results for the quality assurance radiographs can be used to assess the accuracy of the reader's classifications. Based on this assessment, it may be necessary to disregard or adjust the reader's classifications. Results of quality control classifications can also be used to provide feedback to readers to maintain and improve readers' performance (Sheers 1978). Finally, through the inclusion of unidentified calibration radiographs, this approach eliminates the defects in other quality control approaches in which a reader is aware of being evaluated. Although this approach to quality control cannot be expected to eliminate all variation between readers, it should result in the elimination of excesses.

## Reader Panels

The use of reader panels, in which groups of readers jointly classify radiographs and together come to a consensus or unanimous decision, is not usually recommended. Apart from the logistical difficulties of convening such panels, the decisions that are made may fail to represent the true range of opinions in the group. Instead, the joint classifications may reflect those of the most dominant or experienced reader or readers in the group.

## **Precision in Film Classification**

Experience, careful training, and feedback to readers can help maximize precision of classifications among readers. However, as with most other measurements, precision is gained by employing summary indices derived using an index reflecting the central tendency (average) of the multiple determinations. Precision in film classification is gained, therefore, using summary scores based on multiple independent classifications by different readers who classify the films independently (that is without other readers being present and without knowledge of other readers' classifications). The number of independent classifications obtained depends on the setting and on the social and monetary costs involved.

Summary classifications derived from the independent classifications are more precise than any single individual

classification. However, in deriving summary classifications, care should be taken not to introduce bias. Valid summarization methods include the use of median classifications or properly-designed consensus measures.

#### Inter-reader comparisons

In some settings it may be advantageous to undertake preliminary classification activities in which the same radiographs are classified independently by multiple readers, and the findings reported back to the readers. As a form of 'passive' quality control, such information may reveal to a reader his differences from the mainstream, providing the opportunity for education and self-correction to occur. In 'active' quality control, information from such preliminary procedures is employed in the final selection of readers, through the removal of extreme readers at each end of the scale. Similar quality assurance exercises can also be undertaken during the course of any classification process involving multiple readers and radiographs so as to provide continuing feedback and maintenance of standards. Done at the end, they provide a final check on reader consistency. Ultimately, however, such efforts provide only a form of relative quality assurance, in that the readers are compared only to each other and not to objective, external classifications. The only way to ensure true accuracy is to employ concurrent evaluation of calibration radiographs as noted above.

## Reader Selection

Readers should be both proficient and experienced in classifying chest radiographs for the pneumoconioses. Ideally, they should be currently certified B Readers, have extensive experience in classifying radiographs of dust-exposed workers, and be representative of general classification practices among readers (i.e., not falling at either end of the extremes of the range of inter-reader variability). One strategy directed towards ensuring that classifications fall within the mainstream is to select readers randomly from the largest pool of B readers.

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Recommended Practices for Reliable Classification of Chest Radiographs by B Readers





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# Recommended Practices for Reliable Classification of Chest Radiographs by B Readers

There are four necessary components for attainment of reliable classification of chest radiographs for the pneumoconioses: 1) appropriate methods for image collection and viewing, 2) reader competency, 3) commitment to ethical classification, and 4) proper radiographic reading methods.

Recommendations are available for addressing the first component: obtaining chest images of sufficient quality for pneumoconiosis classification and for optimizing viewing conditions (ILO, 42 CFR 37.41 external link). The NIOSH B Reader Certification Program addresses the second component: identification of competency in the classification of radiographs for abnormalities due to dust. The B Reader Code of Ethics addresses the third component in more

The fourth of these components, proper radiographic reading methods, is addressed by the recommended best practices summarized below. Individually designated for each of three principal settings involving chest radiography for pneumoconiosis, these recommended best practices represent practical, real-world approaches tailored to the unique needs of each setting. Details are provided elsewhere on two other settings: Medical Diagnosis and Government Programs. In general, ILO classification of the chest radiograph is not necessary for the former setting, while the latter has specialized guidance that is summarized for each program.

# Worker Monitoring and Surveillance

- 1. ILO system: For consistency with accepted definitions of radiographic appearances of the pneumoconioses and associated disorders, and to ensure uniform standards within a monitoring program and comparability with other data, it is necessary that chest radiographs be classified using the ILO system.
- 2. Remuneration: To avoid biased classifications, it is necessary that a reader's remuneration not be related in any way to classification outcomes.
- 3. Reader selection: Selection of B readers for monitoring programs is generally based on practical considerations, such as availability, access to radiographs, and timeliness.
- 4. Number of readers and summary classifications: A single B reader classification of each chest radiograph is generally sufficient; additional independent classifications may be needed to ensure reliability within the program. Where multiple readings exist, it is desirable that the <u>summarization</u> approach for a specific abnormality be essentially unbiased, with any bias favoring disease detection, (For more details, see Classification of Chest Radiographs: Practices for Worker Monitoring and Surveillance.)
- 5. Blinding: In order to facilitate disease detection in environments where individuals are potentially at risk, blinded classification is undesirable.
- 6. Quality assurance: Formal quality assurance procedures are useful for maintaining accuracy and precision within a program over time. (For more details, see Classification of Chest Radiographs: Practices for Worker Monitoring and Surveillance.)
- 7. Notification: It is ethically necessary to inform individuals of their personal findings, and, if surveillance identifies potential risks of occupational disease within the workplace, inform workers and employers of those risks.

For more details, see Classification of Chest Radiographs: Practices for Worker Monitoring and Surveillance.

# **Epidemiologic Research**

- 1. ILO system: For consistency with accepted definitions of radiographic appearances of the pneumoconioses and associated disorders, and to ensure comparability with other scientific information, it is necessary that chest radiographs be classified using the ILO system.
- 2. Remuneration: To avoid biased classifications, it is necessary that a reader's remuneration must not be related in any way to classification outcomes.

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- 3. Reader selection: To achieve scientifically-accepted standards of precision independent B-reader classifications are necessary. To maximize the likelihood of unbiased classifications, selection of readers should follow scientifically-based criteria established beforehand. (For more details, see <u>Classification of Chest Radiographs: Practices for Epidemiologic Research</u>.)
- 4. Number of readers and summary classification: The ILO recommends at least two but preferably three independent classifications. For the highest flexibility and quality of data, three or more classifications of each radiograph are desirable. To avoid bias, a scientifically acceptable summarization approach is necessary. (For more details, see <u>Classification of Chest Radiographs: Practices for Epidemiologic Research.)</u>
- 5. Blinding: To avoid bias, blinded classification is necessary.
- Quality assurance: To achieve scientifically-accepted standards of accuracy, formal quality assurance
  procedures are necessary. (For more details, see <u>Classification of Chest Radiographs: Practices for</u>
  <u>Epidemiologic Research.</u>)
- 7. Notification: Whenever possible and especially when medical findings are pertinent to maintaining and protecting health, it is ethically necessary to inform the individual of their radiographic findings. (For more details, see <u>Classification of Chest Radiographs: Practices for Epidemiologic Research.</u>) There is ethical justification in notifying member of occupational cohorts and their employers of results of scientific investigations in which they participate.

For more details, see Classification of Chest Radiographs: Practices for Epidemiologic Research.

# **Contested Proceedings**

- 1. *ILO System*: Use of the ILO system provides an accepted means of standardizing disease assessment, and thus is necessary to ensure fairness and equity in contested proceedings.
- 2. Remuneration: To avoid biased classifications it is necessary that a reader's remuneration not be related in any way to classification outcomes.
- 3. Reader selection: To ensure accuracy in classification, it is necessary to select readers at random from the largest pool of B readers available, following a procedure that is defined and documented at the outset. (For more details, see Classification of Chest Radiographs: Practices in Contested Proceedings.)
- 4. Number of readers and summary classifications: To avoid any implication of bias, it is necessary to specify from the outset the number of readers that will be used. It is not acceptable for any party to obtain additional classifications beyond those specified at the beginning of the classification process. NIOSH recommends a minimum of two independent classifications by appropriately selected readers, with a third classification if the first two disagree. The latter is used for resolving disagreement when this is critical to the outcome of the contested proceedings. To permit a full review of the impact of radiograph quality on the reliability of the classifications, it is necessary to report the radiograph quality information from each classification separately. To avoid bias when deriving summary classifications for parenchymal and pleural abnormalities, it is necessary to employ appropriate procedures defined and documented at the outset. (For more details, see Classification of Chest Radiographs: Practices in Contested Proceedings.)
- 5. Blinding: To avoid bias, blinded classification is necessary.
- Quality assurance: The Contested Proceeding setting poses a particular challenge for achieving reliable readings, indicating the necessity of incorporating adequate quality assurance procedures in the classification process. (For more details, see <u>Classification of Chest Radiographs: Practices in Contested Proceedings.</u>)
- 7. Notification: Whenever possible and especially when medical findings are pertinent to maintaining and protecting health, it is ethically necessary to inform the individual of their radiographic findings. (For more details, see Classification of Chest Radiographs: Practices in Contested Proceedings.)

For more details, see Classification of Chest Radiographs: Practices in Contested Proceedings.

## References

International Labour Office (ILO). Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses, Revised Edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva, 2002.

Specifications for medical examinations of underground coal miners. 42CFR37 External link: http://www.access.gpo.gov/nara/cfr/waisidx\_02/42cfr37\_02.html

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# **Chest Radiography**

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## Classification of Chest Radiographs: Practices for Medical Diagnosis

Radiographic medical techniques have long been a powerful adjunct to disease detection and diagnosis. For many decades, the chest radiograph has been the standard approach to assessing dust diseases of the lung, being relatively simple, inexpensive, non-invasive, and safe.

See below for the following topics:

- · The role of classification of chest radiographs in medical diagnosis
- · Special considerations for classification of chest radiographs in medical diagnosis
- · Factors relevant to classification of chest radiographs in medical diagnosis

## The Role of Classification of Chest Radiographs in Medical Diagnosis

Among those with a history of workplace dust exposure, chest radiographs are part of medical testing procedures for dust-induced lung diseases, including the pneumoconioses (e.g., coal workers' pneumoconiosis, silicosis, and asbestosis). It should be stressed, however, that although formal classification of the chest radiograph using the ILO system can at times be useful in furthering accurate diagnosis of disease, in general it is not required.

# Special Considerations for Classification of Chest Radiographs in Medical **Diagnosis**

The American Thoracic Society (ATS) and other medical organizations publish official guidelines for diagnosis and management of certain respiratory diseases, including asbestosis (ATS 2004). These guidelines emphasize the importance of using multiple diagnostic modalities.

Physicians should be aware that dust exposure is not only implicated in the development of the pneumoconioses, but can cause other pulmonary diseases, such as emphysema, COPD, and cancer.

# Factors Relevant to Classification of Chest Radiographs in Medical **Diagnosis**

## 1. ILO classification

ILO classification is not necessary for medical diagnosis of pneumoconiosis. However, the ILO classification system can be useful in describing occupationally-induced abnormalities, if present. If pneumoconiosis is suspected, an ILO classification may eventually be required for participation in Federal or State compensation systems (see sections below on Government Programs and Contested Proceedings).

## 2. Remuneration

Not applicable to medical diagnosis.

#### 3. Reader selection

A B Reader is not required for diagnosis of any pneumoconiosis.

## 4. Number of readers and summary classification methods

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Not applicable to medical diagnosis.

### 5. Blinding

The physician providing the clinical interpretation of the chest radiograph need **not** be blinded to other information pertaining to the patient. In fact, an optimal clinical interpretation takes into account work and exposure history and other medical information concerning the case.

### 6. Quality assurance

Physicians providing the clinical interpretation of the chest radiograph for diagnostic purposes should evaluate their need for participating in **quality assurance** procedures in relation to their involvement in classifying radiographs for other settings ( <u>worker monitoring</u>, <u>epidemiologic research</u>, <u>government programs</u>, or <u>contested proceedings</u>).

#### 7. Notification

Once the diagnosis is made, ethical practice demands that physicians disclose findings to the patient in a timely manner, provide appropriate medical follow-up, educate patients about their illness, and advise them to reduce or eliminate further exposure, as appropriate, in order to prevent progression of the disease.

Physicians should be mindful that recognition of occupational lung disease can provide an opportunity for preventive interventions not only for the affected worker but also for the associated workplace, process, agent, or industry. Physicians and other health care providers are encouraged, and in some states required, to notify their State of diagnosed or suspected cases of occupational pneumoconioses, including silicosis and asbestosis. A chest radiograph classified or otherwise interpreted as consistent with the reportable disease is often considered sufficient evidence to require reporting. If physicians are not already aware of their State reporting requirements, they should contact their state to be apprised of any reporting requirements for which they may be responsible. Contacts for State Public Health Departments can be found on the Association for State and Territorial Health Officials (ASTHO) Web site (external link).

Physicians should also inform their patients about filing deadlines for state Workers' Compensation and Federal Black Lung benefits. Patients should be advised that there are often time limits that apply to how long individuals have to make a claim after they are diagnosed with a compensable disease.

### References

American Thoracic Society. Diagnosis and Initial Management of Nonmalignant Diseases Related to Asbestos. *Am J Respir Crit Care Med* 2004;170:691-715.

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## Classification of Chest Radiographs: Practices for Epidemiologic Research

There is a long and distinguished history of using the ILO classification to derive classifications for input to epidemiologic studies and related activities (i.e., surveillance and hazard investigations). Not only have the results of these studies proven the validity of the ILO classification system and associated methodology, but they have led to hundreds of scientific papers on disease prevalence and its relationship with exposure, time, place, job, and industry. Many findings have been applied to risk analysis, and used for workplace compliance standard setting (e.g., coal mine dust).

See below for the following topics:

- · The role of classification of chest radiographs in epidemiologic research
- · Special considerations for classification of chest radiographs in epidemiologic research
- · Factors relevant to classification of chest radiographs in epidemiologic research

# The Role of Classification of Chest Radiographs in Epidemiologic Research

The pneumoconioses form an important class of occupational respiratory disease, and are a major public health concern. There has been a continuing need not only to estimate disease extent and severity over time and place, but to correlate measures of abnormality with indices of exposure so that exposure-response models can be developed. These findings have provided input to risk analysis, leading to recommendations for occupational exposure levels in the workplace. Surveillance programs enable disease tracking over time and place, indicating whether prevention measures are effective. Hazard investigations provide data on potential risk to workers.

The validity of ILO Classification has been repeatedly demonstrated in many settings and industries. For example, classifications of radiographs of coal miners show clear correlations with dust exposure, lung dust burden, lung pathology, and mortality (Attfield 1992, Ruckley 1984, Miller 1985). Elsewhere, for example, classifications of radiographs of patients with asbestos-related lung disease were shown to be correlated with lung function (Cotes

# Special Considerations for Classification of Chest Radiographs in **Epidemiologic Research**

A chest radiograph classification is one of many other health outcome measurements that have been applied to epidemiologic research. As with any other measurement in epidemiology, a fundamental objective is to ensure that the it meets certain data quality standards: that is, it is necessary to pay attention to accuracy and precision considerations. Traditionally, researchers in research and surveillance have been aware of the need for quality assurance when obtaining classifications for epidemiologic research, and experienced researchers are familiar with the many ways to ensure good data quality. These include procedures for selecting readers, training and assessing readers in pilot studies, simultaneous quality control, use of multiple readers, and use of unbiased summary scoring methods. A useful summary of criteria to consider for epidemiologic purposes is given by Mulloy et al. (1993).

# Factors Relevant to Classification of Chest Radiographs in Epidemiologic Research

### 1. ILO classification

Use of the ILO classification will help maintain consistency with accepted standards of abnormality, ensure

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uniform standards within a program, and ensure comparability with other data.

#### 2. Remuneration

Remuneration that is based on individual classification outcomes or on the overall level of reported abnormality has the obvious potential to cause bias.

#### 3. Reader selection

Reader should have demonstrated skills (e.g., B Readers) and experience. Prior reader selection procedures can be applied, in which preliminary classification exercises are undertaken to assess reader levels, permit training, and eliminate outliers as necessary.

#### 4. Number of readings and summary classifications

The ILO (ILO 2000) recommends a minimum of two classifications, but states that preferably more be obtained. If two classifications are obtained, a third reader can be employed to classify the radiographs where the first two readers disagree, thereby enabling the median of three classifications to be computed for all radiographs. Where resources permit, researchers may prefer to obtain three (or more) <u>independent</u> classifications of all radiographs, because of the higher scientific flexibility and quality that ensues.

Independent classifications from multiple readers are typically combined into a single summary classification. Summarization methods that are unbiased, (i.e., represent the middle of the distribution of classifications), such as use of the median, are preferable. As an alternative to summary classifications, some studies have undertaken analyses by each reader's classifications and averaged the resulting statistics. Use of reader panels in which a summary classification is derived through discussion of the radiograph is not recommended as it has been shown to favor those readers who dominate or are most senior.

#### 5. Blinding

When classifying radiographs for epidemiologic purposes, it is essential to be aware that knowledge of ancillary details specific to individuals can introduce bias into results. This includes medical or exposure information and other readers' interpretations. (ILO 2000) To avoid the effects of any temporal changes in classification practices, radiographs should be randomly allocated to readers.

### 6. Quality assurance

Quality assurance procedures designed to reduce inter-reader variation before the start of a study and to monitor and correct problems during the course of the chest radiograph classification will help optimize the reliability of a study's findings. Simultaneous quality assurance, done by placing unidentified quality control ("calibration") radiographs with a previously established array of parenchymal and/or pleural findings within the set of unknown radiographs being evaluated, provides the most realistic assessment of how readers classify unknown radiographs. Providing feedback comparing the reader's classification of these radiographs to the previously-established classifications has been used to maintain and improve reader performance (Sheers 1978). A National Institutes of Health-sponsored workshop suggested including chest radiographs of unexposed workers in epidemiologic studies for purposes of control (Weill 1975).

In extended reading exercises, in order to avoid the effects of any temporal changes in classification practices across all readers, the readers should classify batches of radiographs in random order.

#### 7. Notification

Whenever possible and especially when individual medical findings are pertinent to maintaining and protecting that individual's health, it is ethically necessary to inform individuals of findings from their individual chest radiograph. Prior unblinded readings may be necessary to provide workers with the best information on their health. However, the information obtained from the research classifications, including the individual and summary classifications, would also be conveyed to the examinee. There is ethical justification in notifying member of occupational cohorts and their employers of results of scientific investigations in which they participate.

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**Draft Topic Page for Comment and Review** NIOSH Docket #085 May 22, 2006

# Classification of Chest Radiographs: Practices for Worker Monitoring and Surveillance

Worker monitoring is an important tool for preventing disease in occupational settings. It is considered a secondary prevention measure, intended to supplement primary prevention approaches (e.g., dust exposure monitoring and control). For the purpose of this document, it refers to using periodic chest radiography to detect pneumoconiosis in dust-exposed or potentially exposed individuals. When positive findings are identified, further medical evaluation of the affected worker may be called for, and workplace interventions that prevent further disease development in the affected individual may be advisable. Workplace surveillance, in which a worker monitoring database is systematically examined for sentinel events and clusters of disease, provides a useful means for identifying and rectifying problems in workplace exposure control impacting groups of workers.

See below for the following topics:

- The role of classification of chest radiographs in worker monitoring and surveillance
- · Special considerations for classification of chest radiographs in monitoring and surveillance
- Factors relevant to classification of chest radiographs in worker monitoring and surveillance
- Other information

# The Role of Classification of Chest Radiographs in Worker Monitoring and Surveillance

There is a long history of using chest radiographs in worker health monitoring for the pneumoconioses. Two examples are the Coal Workers' X-ray Surveillance Program, which is a federal program for the detection of coal workers' pneumoconiosis (CWP) in currently-working underground coal miners. It awards affected individuals the right to work in a reduced dust environment. Another program is the Asbestos Medical Surveillance Program (AMSP) (external link), administered by the Navy Environmental Health Center. The Occupational Safety and Health Administration (OSHA) asbestos standard requires that chest radiographs obtained for surveillance of those exposed to asbestos be interpreted and classified by a B Reader, radiologist, or physician with expertise in pneumoconioses. OSHA (external link) also specifies B Readers and the International Labour Office (ILO) Classification in its asbestos safety and health standards for general industry, construction, and shipyard employment.

Physicians and other health care providers are encouraged, and sometimes required, to notify their State of diagnosed or suspected cases of occupational pneumoconioses, including silicosis and asbestosis. A chest radiograph classified or otherwise interpreted as consistent with the reportable disease is often considered sufficient evidence to require reporting. If physicians are not already aware of their State reporting requirements, they should contact their State to learn about any reporting requirements for which they may be responsible. Contacts for State Public Health Departments can be found on the Association for State and Territorial Health Officials (ASTHO) Web site (external link).

# Special Considerations for Classification of Chest Radiographs in Worker Monitoring and Surveillance

Worker monitoring typically involves the screening of large numbers of individuals, and hence can be costly. Therefore, use of single classifications, at some acknowledged sacrifice in reliability, may be required for a program to operate at all. However, reliance on single classifications is not a major issue because most workers are healthy, and because provisions can be made to deal with the possible limited reliability arising from reliance on single classifications. A monitoring program needs to be sensitive to detection of early disease, implying that any doubt be resolved on the side of disease detection. False positive cases are limited by undertaking further evaluation. Hence, if a possible case is identified, by the initial single reading, further classifications and confirmatory studies can be subsequently applied before intervention is implemented.

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In light of the above considerations, in worker health monitoring programs it is acceptable to classify films <a href="unblinded">unblinded</a> to information on the occupational history and exposures of the examinees. This may permit the reader to be sensitive as possible to the early changes that might be expected from the workplace exposures.

# Factors Relevant to Classification of Chest Radiographs in Worker Monitoring and Surveillance

#### 1. ILO classification

Use of the ILO classification will help maintain consistency with accepted standards of abnormality, ensure uniform standards within a program, and ensure comparability with other data.

#### 2. Remuneration

Reader remuneration that is based on individual classification outcomes or on the overall level of reported abnormality has the obvious potential to cause bias.

#### 3. Reader selection

Readers should be knowledgeable and experienced in the principles and practice of classification using the ILO system (e.g., B readers).

#### 4. Number of readers and summary classification

A single classification of each radiograph is generally sufficient, particularly for radiographs that are clearly normal or abnormal. Radiographs indicating abnormality on the normal/abnormal boundary could benefit from further classification by one (or more) further readers in order to reach a more definitive conclusion on abnormality and thus improve the reliability of any resulting decisions concerning interventions. <a href="Summarization">Summarization</a> procedures for multiple classifications should strive to be unbiased (that is, represent the central tendency within the set of multiple classifications), although in cases of doubt, they should favor the protection of workers' health. (See the description of summarization procedures for <a href="Contested Proceedings">Contested Proceedings</a> for possible strategies that may be useful in worker monitoring.)

#### 5. Blinding

Knowledge of exposures and jobs worked when classifying a radiograph may be helpful in reducing uncertainty in assessing a worker's medical status. Hence, blinding is not necessary.

#### 6. Quality Assurance

Readers who are routinely engaged in classifying radiographs for monitoring programs can increase the reliability of their classifications by engaging in various forms of **quality assurance**. Re-classification radiographs and comparison with past classifications can help prevent reader drift over time. Comparison of classifications from other readers or concurrent classification of calibration radiographs (specially selected radiographs that have been previously classified by expert readers) are ways to ensure that classification levels lie close to the mainstream.

## 7. Notification

It is ethically necessary to inform individual workers of findings from their individual chest radiograph. If during the course of workplace surveillance activities potential risks of occupational disease within the workplace are identified through observation of sentinel events or through tabulation of monitoring data by job, tenure, or other relevant category, ethical practice calls for workers and their employer to be informed of the identified potential risks.

## Other Information

## Use of monitoring data for population-based surveillance

Information from worker monitoring programs can be useful for population-based surveillance. For this to be effective, care must be taken to ensure that the monitoring information is representative of the population so that the prevalence statistics are valid and unbiased, and that the data are sufficiently reliable for the purpose. To achieve the latter objective, additional classifications may be necessary to improve precision. The NIOSH Coal

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Workers' X-Ray Surveillance Program is a worker monitoring program that employs at least two classifications of each radiograph summarized using a standardized algorithm ( <u>42CFR37</u> (external link)). Data from this program are employed in population-based surveillance and reported on the NIOSH website (see the <u>Occupational</u> Respiratory Disease Surveillance (ORDS) pages).

## Employers should follow the OSHA asbestos standard

The Occupational Safety and Health Administration (OSHA) asbestos standard (external link) requires that chest radiographs obtained for surveillance of those exposed to asbestos be interpreted and classified by a B Reader, radiologist, or experienced physician with expertise in pneumoconioses. OSHA also specifies B Readers and the International Labour Office (ILO) Classification in its asbestos safety and health standards for general industry, construction, and shipyard employment.

#### Coal Mine Operators Should Report Silicosis and Other Pneumoconioses

The Mining Safety and Health Administration (MSHA) requires that any diagnosis of a dust disease or illness must be reported under MSHA 30 CFR 50. For purposes of reporting, MSHA considers that any miner with a history of exposure to silica or other pneumoconiosis-causing dusts and a small opacity profusion score of 1/0 or greater has illness that should be reported. The MSHA Program Policy Manual (external link), pages 63 through 65, contains specific guidance for reporting requirements, including criteria for ILO Classification and procedures for second interpretations.

#### References

Coal Workers' X-Ray Surveillance Program. National Institute for Occupational Safety and Health. How can I learn more about my transfer options?

#### Asbestos Medical Surveillance Program. Navy Environmental Health Center

External Link: http://www-nehc.med.navy.mil/occmed/Asbestos.htm

## Safety and Health Topics: Asbestos. Occupational Safety and Health Administration

External Link: http://www.osha.gov/SLTC/asbestos/index.html

#### Association for State and Territorial Health Officials

External Link: http://www.astho.org/

## Specifications for Medical Examinations of Underground Coal Miners. 42CFR37

External Link: http://www.access.gpo.gov/nara/cfr/waisidx\_02/42cfr37\_02.html

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# Classification of Chest Radiographs: Practices for Determining Government **Program Eligibility**

The information on this page refers to classification of chest radiographs that are made for certain federal programs that award disability benefits. A brief description of each of the major programs is given below; each has its own classification procedures and criteria.

# **Program Information**

### Federal Black Lung Benefits Program

Physicians performing medical testing for the Black Lung Benefits Program should follow regulations found in 20CFR718.102, 718.202, and Appendix A (external link). Further information on claims can be found under CFR Title 20, Chapter VI, Part 725 (external link). These regulations specify what medical testing must be done as well as the film and equipment that must be used for radiography. Chest radiographs must be classified using the International Labour Office (ILO) Classification system (ILO 2002). To find out about eligibility for Federal Black Lung Benefits, contact the nearest Black Lung Benefits Office (external link).

## The Energy Employees Occupational Illness Compensation Program

The Energy Employees Occupational Illness Compensation Program Act of 2000 provides compensation for employees or eligible survivors of employees of the Department of Energy, its predecessor agencies, and its contractors and subcontractors who became ill as a result of the work performed in the production and testing of nuclear weapons. Silicosis is a covered condition under the Act. Physicians should follow regulations regarding medical diagnosis of chronic silicosis for the Energy Employees Occupational Illness Compensation Program (external link). A written diagnosis of silicosis must be made by a medical doctor along with a chest radiograph, results of other imaging techniques, or a lung biopsy. If a chest radiograph is submitted, it must be classified by a B Reader.

## State Workers' Compensation Programs

State Workers' Compensation programs are completely separate from federal benefits programs. Some individuals may qualify for one program and not the other. State disability benefits and compensation differ by state, so contact the State Office of Worker's Compensation (external link) to learn about compensation from the State Governments. There are often time limits that apply to how long individuals have to make a claim after the worker is diagnosed with a compensable disease, so workers should be encouraged to avoid delay in contacting the relevant state office.

## References

Standards for Determining Coal Miners' Total Disability or Death Due to Pneumoconiosis. 20CFR718 External Link: http://www.dol.gov/dol/allcfr/Title\_20/Part\_718/toc.htm

Claims for Benefits Under Part C of Title IV of the Federal Mine Safety and Health Act, As Amended. 20CFR725 External Link: http://www.dol.gov/dol/allcfr/Title\_20/Part\_725/toc.htm

International Labour Office (ILO). Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses, Revised Edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva. 2002.

Black Lung Benefits Offices. Division of Coal Mine Workers' Compensation Program and District Offices,

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#### **Department of Labor**

External Link: http://www.dol.gov/esa/contacts/owcp/blcontac.htm

<u>Energy Employees Occupational Illness Compensation Program Act of 2000</u>, as described on the US Department of Labor compliance assistance web site.

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External Link: http://www.dol.gov/esa/regs/compliance/owcp/ca\_eeoic.htm

## State Workers' Compensation Officials. US Department of Labor

External Link: http://www.dol.gov/esa/regs/compliance/owcp/wc.htm

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## Classification of Chest Radiographs: Practices in Contested Proceedings

The setting of contested proceedings presents special challenges to obtaining accurate chest radiograph classifications. The polarized interests of conflicting parties create a situation where diligence and special care are needed to ensure that classifications are accurate. As in other settings, it is important to remember that chest radiograph findings alone are insufficient for the diagnosis of pneumoconiosis. Other data, such as the medical and occupational history, the physical examination, additional types of chest imaging, various laboratory tests, and biopsy results should also be considered, as available. It should be noted that the presence of a diagnosis does not necessarily imply functional impairment. The American Medical Association's Guides to the Evaluation of Permanent Impairment provides useful guidelines for assessing the presence and severity of impairment.

See below for the following topics:

- The role of classification of chest radiographs in contested proceedings
- Special considerations for classification of chest radiographs in contested proceedings
- Factors relevant to classification of chest radiographs in contested proceedings

# The Role of Classification of Chest Radiographs in Contested Proceedings

The International Labour Office (ILO) recognizes the limitations of using the ILO Classification System to make decisions for awarding compensation. The 2000 ILO Classification Guidelines state explicitly that classification "does not imply legal definitions of pneumoconiosis for compensation purposes and does not set or imply a level at which compensation is payable" (ILO 2000). Despite these cautions, ILO classifications that fit certain definitions of abnormality are frequently considered in decisions concerning compensation awards. Parenchymal abnormalities, in particular small opacity profusion classifications of 1/0 or greater, are frequently considered to be consistent with pneumoconiosis in compensation proceedings. Pleural abnormalities can also be used to document the presence of adverse outcomes to occupational dust exposure. Use of standardized ILO classifications in contested proceedings helps to assure that chest radiographs are evaluated in way that is fair, consistent, and reproducible across geography and time.

# Special Considerations for Classification of Chest Radiographs in **Contested Proceedings**

The setting of contested proceedings presents special challenges to obtaining accurate chest radiograph classifications. The environment is often adversarial. Unfortunately, the competing desires for a favorable outcome by the contending parties can result in pressure for classifications biased in opposite directions. There are various ways for bias to occur. Classifications of chest radiographs made with knowledge of whether the classification is for a plaintiff or defendant, or with knowledge of individual or group data on exposures or health status, can lead to results that favor reporting the presence or absence of abnormality. In addition, selection of readers with known or suspected high or low classification tendencies, payment based on outcome, and lack of quality assurance are all factors that can result in bias.

Owing to the pressures involved in contested proceedings, diligence and special care is needed to ensure that classifications are not biased. However, acquisition of reliable classifications is possible, while at the same time ensuring that the process is fair to all parties.

NIOSH has prepared some ethical guidelines that should be considered when readers classify radiographs in contested settings. The American Medical Association, the American College of Radiologists and other medical organizations have published guidelines for physicians serving as expert witnesses. All of them discuss the need to be impartial, objective, and unbiased. Testimony must be scientifically valid and be able to withstand peer review (ACR 2002, AMA external links).

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# Factors Relating to Classification of Chest Radiographs in Contested Proceedings

#### 1. ILO classification

Use of the ILO system provides an accepted means of standardizing disease assessment – a necessary condition for ensuring fairness and equity.

#### 2. Remuneration

Remuneration that is based on individual classification outcomes or on the overall level of reported abnormality has the obvious potential to cause bias.

## 3. Reader selection

To maintain quality and avoid bias it is necessary that readers have a high level of knowledge and skills relating to the ILO classification and the pneumoconioses (e.g., B Readers). Reader selection founded on known or suspected reading tendencies will obviously lead to bias. To avoid such bias, it is best that readers be selected randomly from the largest pool of available B readers. Precise documentation of the reader selection procedures for all classifications is necessary to permit assessment of the reader selection methodology.

## 4. Number of readers and summary classification

To avoid any implication of bias, it is necessary to specify from the outset the number of readers that will be used. The process of undertaking serial classifications until one(s) are obtained that suit a particular viewpoint is clearly inappropriate. Rather, for attainment of reliable radiograph classification, a minimum of two <a href="independent">independent</a> classifications by readers selected at the outset is advisable, with a third required if a certain level of disagreement is encountered, as described below. In order to derive fair and consistent <a href="mailto:summary">summary</a> classifications from the individual independent classifications, it is necessary to specify the summarization procedures beforehand:

- a. Small opacities: When the first two independent classifications both indicate 1/0 or greater profusion or both indicate 0/1 or lower, take the higher of the two profusions as the final summary classification. Otherwise, if one classification is 0/1 or lower and the other is 1/0 or greater, obtain a third independent classification and take the median of the three as the final summary classification.
- b. Large opacities: When the first two independent classifications of a radiograph both identify large opacities, take the higher of the two large opacity categories as the final summary classification. When only one of the first two classifications identifies a large opacity and the other identifies coalescence of small opacities (symbol "ax"), take the category of large opacity as the summary classification. Otherwise, obtain a third independent classification, if not already done, and take the median of the three large opacity categories as the summary classification.
- c. Pleural abnormalities: When two or more independent classifications of a radiograph find the presence of pleural abnormalities with any agreement on side (left or right) and location (diaphragm, face on, profile, or other site), take the final summary classification to be presence of pleural abnormality on the side(s) and location(s) where there was agreement as the summary classification.
- d. Other abnormalities ("obligatory symbols"): Include each obligatory symbol recorded in two or more classifications in the final summary classification. When both large opacities and the symbol "ax" are reported by any reader, include "ax" in the summary classification.
- e. Film quality: When a reader classifies a radiograph as unreadable, a further classification by a reader selected from the pool of available readers is appropriate. To provide a comprehensive summary indication of the quality of the radiograph, it is necessary to take all assessments into account. The average of all quality scores from each independent classification (with "unreadable" [U/R] scored as 4) provides an overall index reflecting the extent of the reliability of the summary classification for the radiograph.

### 5. Blinding

When classifying radiographs it is necessary that the reader does not consider any other information about the individuals being studied, including medical data, exposure information, the context and consequences of the classification, or other readers' interpretations. Awareness of supplementary details specific to individuals, the group, or situation can introduce bias into results.

## 6. Quality assurance

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The need for accurate, unbiased classification lies at the core of classification in contested proceedings. Standardized and carefully documented quality assurance procedures are advisable, especially for entities involved in obtaining many radiograph classifications per year (e.g., classifications for 100 people or more). It is best that readers know that quality assurance procedures are being implemented, as this alone is a motivation to accurate classification. Concurrent quality assurance, using unidentified radiographs representing known (i.e., previous ascertained using expert readers) positive and negative stages of the disease abnormality under consideration, provides the optimal approach to ensuring quality. The resulting information on possible over- or underclassification tendencies can be used by the entity for which the radiographs are being classified in several ways. These range from simply informing readers of their own classification levels to removing specific readers from the pool based on significant and documented evidence.

#### 7. Notification

Whenever medical findings are pertinent to maintaining and protecting health, it is ethically necessary to inform examined individuals of findings from their individual chest radiograph, including all information from the individual and summary classifications. Documentation of efforts to notify individuals is advisable.

### References

International Labour Office (ILO). Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses, Revised Edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva, 2002.

American College of Radiology (ACR). ACR Practice Guideline on the Expert Witness in Radiology. 2002 (Res. 43). Effective 1/1/03 (This Web site is not a direct link.)

External Link: http://www.acr.org

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## **Best Technical Practices**

Radiographic classifications are a validated methodology for detecting and assessing certain occupationallyinduced lung diseases. In this, the International Labour Office (ILO) International Classification of Radiographs of the Pneumoconioses (ILO 2000) describes a systematic approach for obtaining standardized classifications. The usefulness of the approach has been demonstrated repeatedly. ILO classifications of radiographs have shown clear correlations with dust exposure, lung dust burden, lung pathology, mortality, and lung function (e.g., Attfield and Morring, 1992; Ruckley et al., 1984; Miller and Jacobsen, 1985, and Cotes and King, 1988).

See below for the following topics:

- The need for good quality radiographic techniques and equipment
- The role of the NIOSH B Reader Program

# The Need for Good Quality Radiographic Techniques and Equipment

It has long been recognized that both the technique and the equipment used for chest radiographic imaging of dustexposed workers affect the ability to detect and assess abnormalities, and that this can impact the classification of the radiograph for disease. Consequently, it may be difficult or impossible to classify radiographs using the ILO system if the quality of the image is poor.

When obtaining radiographs for assessment using the ILO classification, development and adoption of a protocol giving clear quality control guidelines is necessary to avoid later problems in classification. For example, in the NIOSH Coal Workers' X-ray Surveillance Program there are strict requirements relating to the radiographic film, exposures, and equipment that must be used. Additionally, before radiographs may be submitted to NIOSH under the program, sample images from each radiographic unit must be evaluated and approved by NIOSH ( 42CFR37 external link)

# The Role of the NIOSH B Reader Program

In the United States, the B Reader Program has played a major role in advancing knowledge of radiographic classification using the ILO system. The B Reader certification examination, administered by NIOSH, is a rigorous evaluation of physicians' capability to identify and appropriately classify radiographic appearances associated with dust-related disease.

Physicians who classify chest radiographs for certain federal surveillance may be required to be B Readers. For example, in the NIOSH Coal Workers' X-ray Surveillance Program, physicians who classify radiographs for the program are required to be B Readers for the second and any later readings of each radiograph ( 42CFR37 external link). The Asbestos Medical Surveillance Program (external link), administered by the Navy Environmental Health Center, requires that the second reader of each radiograph be a B Reader, B Readers also have important roles to play in epidemiologic research, government programs, and contested proceedings.

# References

International Labour Office (ILO). Guidelines for the use of the ILO International Classification of Radiographs of Pneumoconioses. Revised edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva, 2002.

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Attfield MD, Morring K. An investigation into the relationship between coal workers' pneumoconiosis and dust exposure in U.S. coal miners. *Am Ind Hyg Assoc J* 1992; 53:486-92.

Ruckley VA, Fernie JM, Chapman JS, et al. Comparison of radiographic appearance with associated pathology and lung dust content in a group of coal workers. *Br J Ind Med* 1984; 41:459-67.

Miller BG, Jacobsen M. Dust exposure, pneumoconiosis, and mortality of coal miners. *Br J Ind Med* 1985; 42:723-33.

Cotes JE, King B. Relationship of lung function to radiographic reading (ILO) in patients with asbestos related lung disease. *Thorax* 1988; 43:777-83.

<u>Asbestos Medical Surveillance Program.</u> Navy Environmental Health Center. External link: http://www-nehc.med.navy.mil/occmed/Asbestos.htm

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## Glossary of Terms

Classification: In these web pages this is short for ILO classification, the assessment of a radiograph for abnormalities associated with the pneumoconioses and certain other lung diseases or chest abnormalities using the standard definitions, procedures, and radiographs of the ILO system.

Blinding: Blinding is intended to prevent bias by hiding ancillary information from a reader. For a fully blinded classification, information on the reason for the reading (e.g., a contested application for compensation), the entity requesting the reading (e.g., representative of a plaintiff or defendant), the underlying source or nature of the radiographs (e.g., a cohort of sandblasters), and the examinee's personal information (e.g., industry, job, tenure, and other health information) is not available to the reader.

Summarization: When multiple classifications exist, it is frequently necessary to derive a summary classification representing in some way the average of these multiple classifications for the specific abnormality under investigation. Various approaches are possible, and are described in the web pages for each setting.

Quality assurance: Quality assurance is the process of ensuring that classifications are sufficiently accurate for the specific setting. General information on accuracy is provided on the Issues in Classification of Chest Radiographs page, while details on quality assurance procedures are provided on the web pages for each setting.

Independence: With independent classification, multiple readers each classify the radiographs separately without other readers being present, and without knowledge of the classifications of other readers.

Surveillance: In the worker monitoring setting, surveillance is the periodic and systematic examination of the monitoring database to identify at-risk groups of workers using sentinel events and tabulation by logical categories of workers and cases.

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## Resources

This section contains a listing of all the references (journal articles, books, Web sites, federal laws and regulations) used on this Web site as well as additional information related to the topics of chest radiography, the International Labour Office (ILO) Classification system, and the pneumoconioses.

If you are unable to find the information you are looking for on this Web site, please contact the B Reader Program office at (888) 480-4042 or email CWHSP@cdc.gov, and we will be happy to assist you.

# **Related NIOSH Topic Pages**

#### **Asbestos**

Coal Workers' Health Surveillance Program Occupational Respiratory Disease Surveillance Pneumoconioses

## **Journal Articles**

American Thoracic Society. Diagnosis and Initial Management of Nonmalignant Diseases Related to Asbestos. Am J Respir Crit Care Med 2004;170:691-715.

Attfield MD, Morring K. An investigation into the relationship between coal workers' pneumoconiosis and dust exposure in U.S. coal miners. Am Ind Hyg Assoc J 1992; 53:486-92.

Bohlig H, Bristol LJ, Cartier PH, Felson B, Gilson JC, Grainger TR et al. UICC/Cincinnati classification of the radiographic appearances of pneumoconiosis. Chest 1970;58:57-67.

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Fay JWJ, Rae S. The Pneumoconiosis Field Research of the National Coal Board. Ann Occup Hyg 1959; 1:149-61.

Felson B, Morgan WKC, Bristol LJ, Pendergrass E, Dessen EL, Linton OW et al. Observations on the results of multiple readings of chest films in coal miners' pneumoconiosis. Radiology 1973;109:19-23.

Fletcher CM, Oldham PD. The problem of consistent radiological diagnosis in coalminers' pneumoconiosis. An experimental study. Br J Ind Med 1949;6:168-183.

Hurley JF, Burns J, Copland L, et al. Coalworkers' simple pneumoconiosis and exposure to dust at 10 British coalmines. Br J Ind Med 1982; 39:120-7.

Jacobsen M. Part 5. Radiologic Abnormalities: Epidemiologic Utilization: The International Labour Office

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Classification: Use and Misuse. AnnalsNew YorkAcademy of Sciences 1991; 643:100-107.

Miller BG, Jacobsen M. Dust exposure, pneumoconiosis, and mortality of coal miners. *Br J Ind Med* 1985; 42:723-33.

Morgan RH. Proficiency examination of physicians for classifying pneumoconiosis chest films. *Am J Roentgenology* 1979;132:803-08.

Mulloy KB, Coultas DB, Samet JM. Use of chest radiographs in epidemiological investigations of pneumoconioses. *Br J Ind Med* 1993; 50(3):273-5.

Parker DL, Bender AP, and Hankinson S. Public Health Implications of the Variability in the Interpretation of 'B' Readings for Pleural Changes. *Journal of Occupational Medicine* 1989; 31(9):775-780.

Reger RB, Amandus HE, Morgan WKC. On the diagnosis of coalworkers' pneumoconiosis - Anglo-American disharmony. *Am Rev Respir Dis* 1973;108:1186-91

Reger RB, Petersen MR, Morgan WKC. Variation in the interpretation of radiographic change in pulmonary disease. *Lancet* 1974;111-13.

Richman SI and Smith CJ. Legal Aspects of Impairment and Disability in Pneumoconiosis. *Occupational Medicine: State of the Art Reviews* 1993; 8(1) 71-92.

Ruckley VA, Fernie JM, Chapman JS, et al. Comparison of radiographic appearance with associated pathology and lung dust content in a group of coalworkers. *Br J Ind Med* 1984; 41:459-67.

Sheers G, Rossiter CE, Gilson JC, Mackenzie FAF. UK naval dockyards asbestos study: radiological methods in the surveillance of workers exposed to asbestos. *Br J Ind Med* 1978; 35:195-203.

Weill H, Jones R. The chest roentgenogram as an epidemiologic tool. Report of a workshop. *Arch Environ Health* 1975: 30:435-9.

Wagner GR, Attfield MD, Parker JE. Chest Radiography in Dust-Exposed Miners: Promise and Problems, Potential and Imperfections. *Occupational Medicine: State of the Art Reviews* 8(1); 127-141, 1993.

## Books

International Labour Office (ILO). Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses, Revised Edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva, 2002.

Morgan RH. Radiology. In: Merchant JA, ed. *Occupational Respiratory Diseases*. (NIOSH Publication No. 86-102), 1986.

Antao VC, Parker JE. ILO Classification. In: Gevenois, PA & De Vuyst P, eds., *Imaging of Occupational and Environmental Disorders of the Chest. Berlin. Springer*, 2006, pp: 93–99. ISBN – 3540213430.

## Web sites

#### American College of Radiology

External Link: http://www.acr.org/s\_acr/index.asp

American College of Radiology (ACR). <u>ACR Practice Guideline on the Expert Witness in Radiology</u>. 2002 (Res. 43). Effective 1/1/03 (This Web site is not a direct link.)

External Link: http://www.acr.org/s\_acr/bin.asp?TrackID=&SID=1&DID=12217&CID=541&VID=2&DOC=File.PDF

American Medical Association. H-265.994, <u>Expert Witness Testimony</u>. (Sub. Res. 223, A-92; Appended: Sub. Res. 211, I-97; Reaffirmation A-99) (This Web site is not a direct link.)

External Link: http://www.ama-assn.org/ama/noindex/category/11760.html

### Asbestos Medical Surveillance Program. Navy Environmental Health Center

External Link: http://www-nehc.med.navy.mil/occmed/Asbestos.htm

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Federal Laws and Regulations

### Association of Occupational and Environmental Clinics

External Link: http://www.aoec.org/

#### Association for State and Territorial Health Officials

External Link: http://www.astho.org/

#### Black Lung Benefits Act (BLBA)

External Link: http://www.dol.gov/compliance/laws/comp-blba.htm

# Black Lung Benefits Offices. Division of Coal Mine Workers' Compensation Program and District Offices, Department of Labor

External Link: http://www.dol.gov/esa/contacts/owcp/blcontac.htm

# Black Lung Benefits Program. Division of Coal Mine Workers' Compensation Program and District Offices, Department of Labor

External Link: http://www.dol.gov/esa/regs/compliance/owcp/bltable.htm

## Black Lung Clinics Program. Bureau of Primary Health Care, Health Resources and Services Administration

External Link: http://bphc.hrsa.gov/blacklung/

#### Campaign to End Black Lung Now and Forever

External Link: http://www.msha.gov/s&hinfo/blung/homepage.htm

Coal Workers' Health Surveillance Program. National Institute for Occupational Safety and Health

# Coal Workers' X-Ray Surveillance Program. National Institute for Occupational Safety and Health. Frequently Asked Questions and Resource List

# <u>Energy Employees Occupational Illness Compensation Program Act of 2000</u>, as described on the US Department of Labor compliance assistance web site.

External Link: http://www.dol.gov/esa/regs/compliance/owcp/ca\_eeoic.htm

## Federal Mine Safety & Health Act of 1977

External Link: http://www.msha.gov/regs/act/acttc.htm

#### Federation of State Medical Boards

External Link: http://www.fsmb.org/

## Mine Safety and Health Administration

External Link: http://www.msha.gov

#### Occupational Respiratory Disease Surveillance. National Institute for Occupational Safety and Health

# Roentgenographic Interpretation Form. B Reader Certification Program. National Institute for Occupational Safety and Health

## Safety and Health Topics: Asbestos. Occupational Safety and Health Administration

External Link: http://www.osha.gov/SLTC/asbestos/index.html

## State Workers' Compensation Officials. US Department of Labor

External Link: http://www.dol.gov/esa/regs/compliance/owcp/wc.htm

## Federal Laws and Regulations

# Claims for Benefits Under Part C of Title IV of the Federal Mine Safety and Health Act, As Amended. 20CFR725

External Link: http://www.dol.gov/dol/allcfr/Title\_20/Part\_725/toc.htm

Federal Mine Safety and Health Act of 1977, Public Health Law 91-173

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## Specifications for Medical Examinations of Underground Coal Miners. 42CFR37

External Link: http://www.access.gpo.gov/nara/cfr/waisidx\_02/42cfr37\_02.html

## Standards for Determining Coal Miners' Total Disability or Death Due to Pneumoconiosis. 20CFR718

External Link: http://www.dol.gov/dol/allcfr/Title\_20/Part\_718/toc.htm

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